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Housley

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[45] Date of Patent: *Jun. 30, 1998

[54] **PROGRAMMABLE DOORBELL CONTROL**

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[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,210,520.

[21] Appl. No.: **231,615**

[22] Filed: **Apr. 22, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 62,615, May 11, 1993, abandoned, which is a continuation of Ser. No. 735,096, Jul. 23, 1991, Pat. No. 5,210,520, which is a continuation of Ser. No. 408,613, Sep. 18, 1989, abandoned, which is a continuation-in-part of Ser. No. 73,456, Jul. 15, 1987, Pat. No. 4,868,540.

[51] **Int. Cl.**[6] **G08B 27/00**

[52] **U.S. Cl.** **340/326**; 340/392; 340/330; 379/56; 379/67

[58] **Field of Search** 340/326, 330, 340/328, 329, 392, 393; 379/103

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,148,468 9/1992 Marrick et al. 379/56

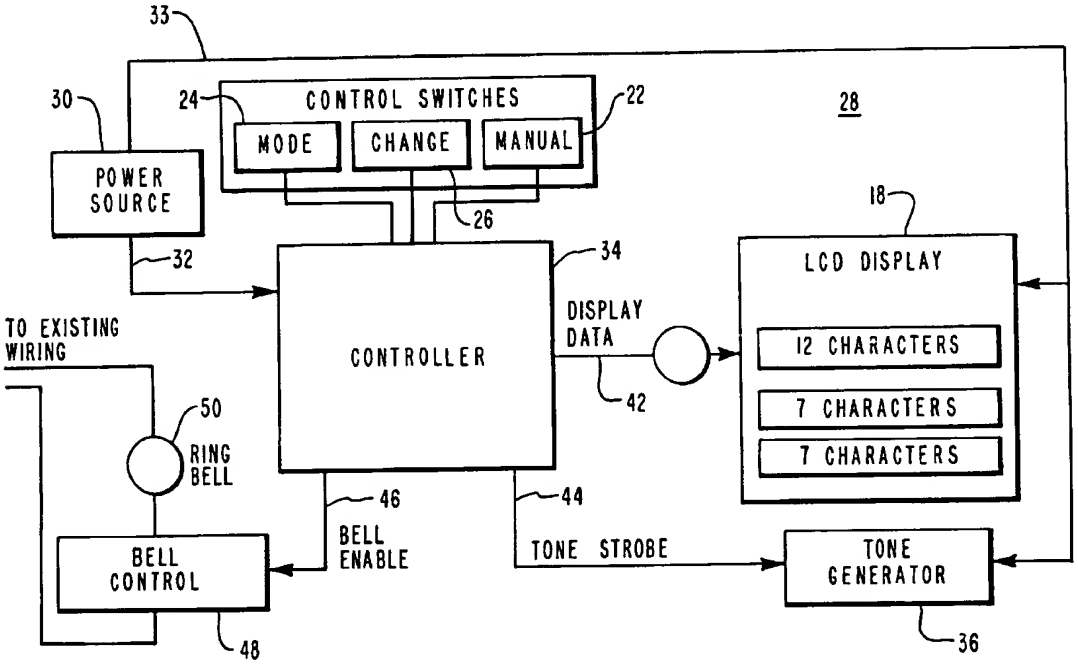
5,210,520 5/1993 Housley 340/326

Primary Examiner—Jeffery A. Hofsass
Assistant Examiner—Daryl C. Pope

[57] **ABSTRACT**

A programmable doorbell controller for the operation of a doorbell. In a preferred embodiment, an audible announcement is recorded and stored by a doorbell control module using speech controller integrated circuitry. A self-contained remote module may interface with the doorbell control module by means of a wireless intercom system. When the doorbell actuation means is actuated, the remote module transmits a tone or signal that is received and detected by the doorbell control module. In response, the doorbell control module activates an internal speech controller circuitry to generate a playback of a stored audible announcement. Similarly, a visitor can easily respond by actuating a recording actuation means to activate a microphone for generating a responsive audible message that can be transmitted to the control module for encoding and storage. In this manner, the visitor's audible message is encoded, recorded and stored by the speech controller integrated circuitry of the control module for playback.

29 Claims, 10 Drawing Sheets



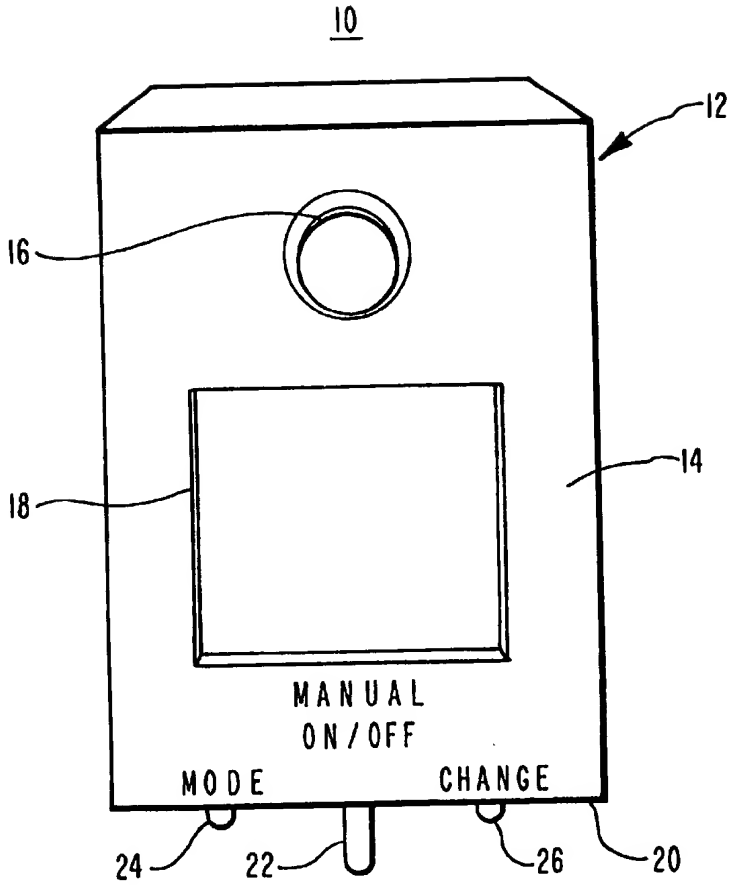


FIG. 1

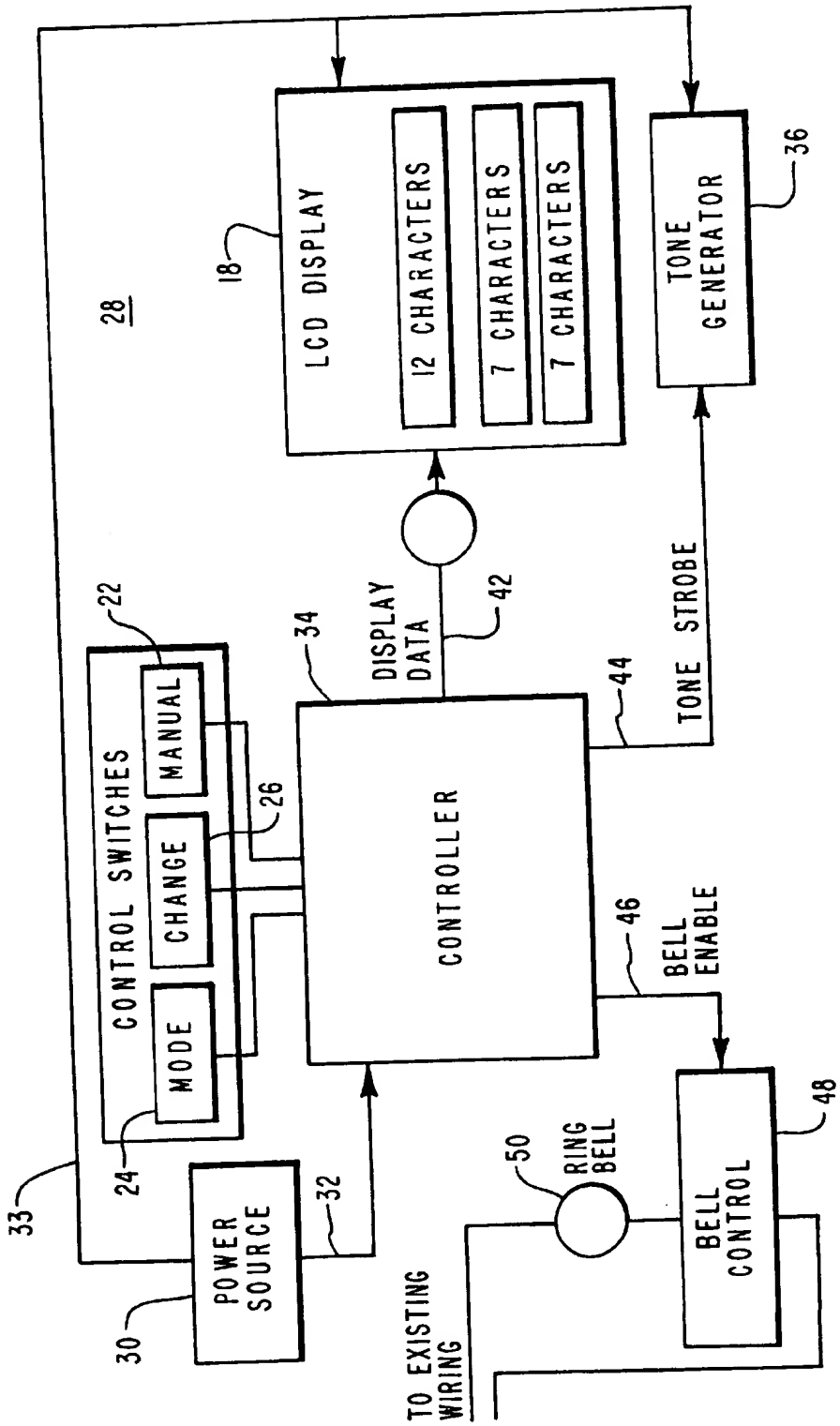

28
18
LCD DISPLAY
12 CHARACTERS
7 CHARACTERS
7 CHARACTERS
36
TONE GENERATOR
22
CONTROL SWITCHES
MANUAL
CHANGE
MODE
26
24
33
34
DISPLAY DATA
42
CONTROLLER
44
TONE STROBE
46
BELL ENABLE
POWER SOURCE
30
32
50
RING BELL
BELL CONTROL
48
TO EXISTING WIRING

FIG. 2

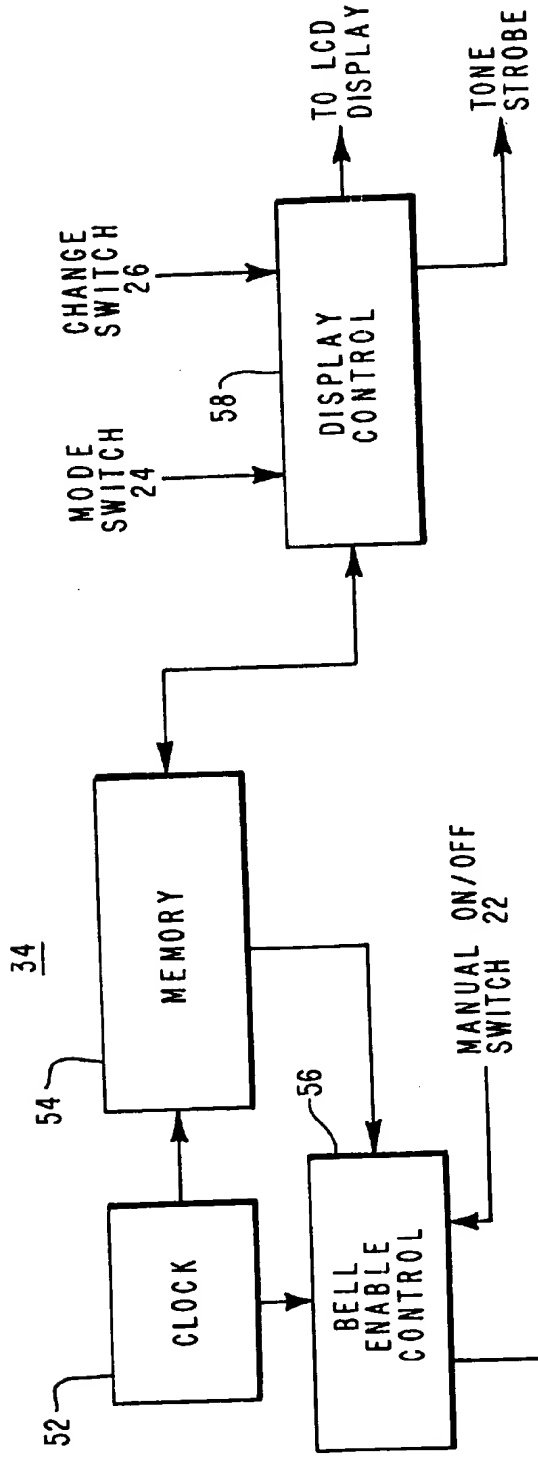

TO LCD DISPLAY
TONE STROBE
CHANGE SWITCH 26
58
DISPLAY CONTROL
MODE SWITCH 24
34
MEMORY
54
56
MANUAL ON/OFF SWITCH 22
BELL CONTROL 48
CLOCK
BELL ENABLE CONTROL
52

FIG. 3

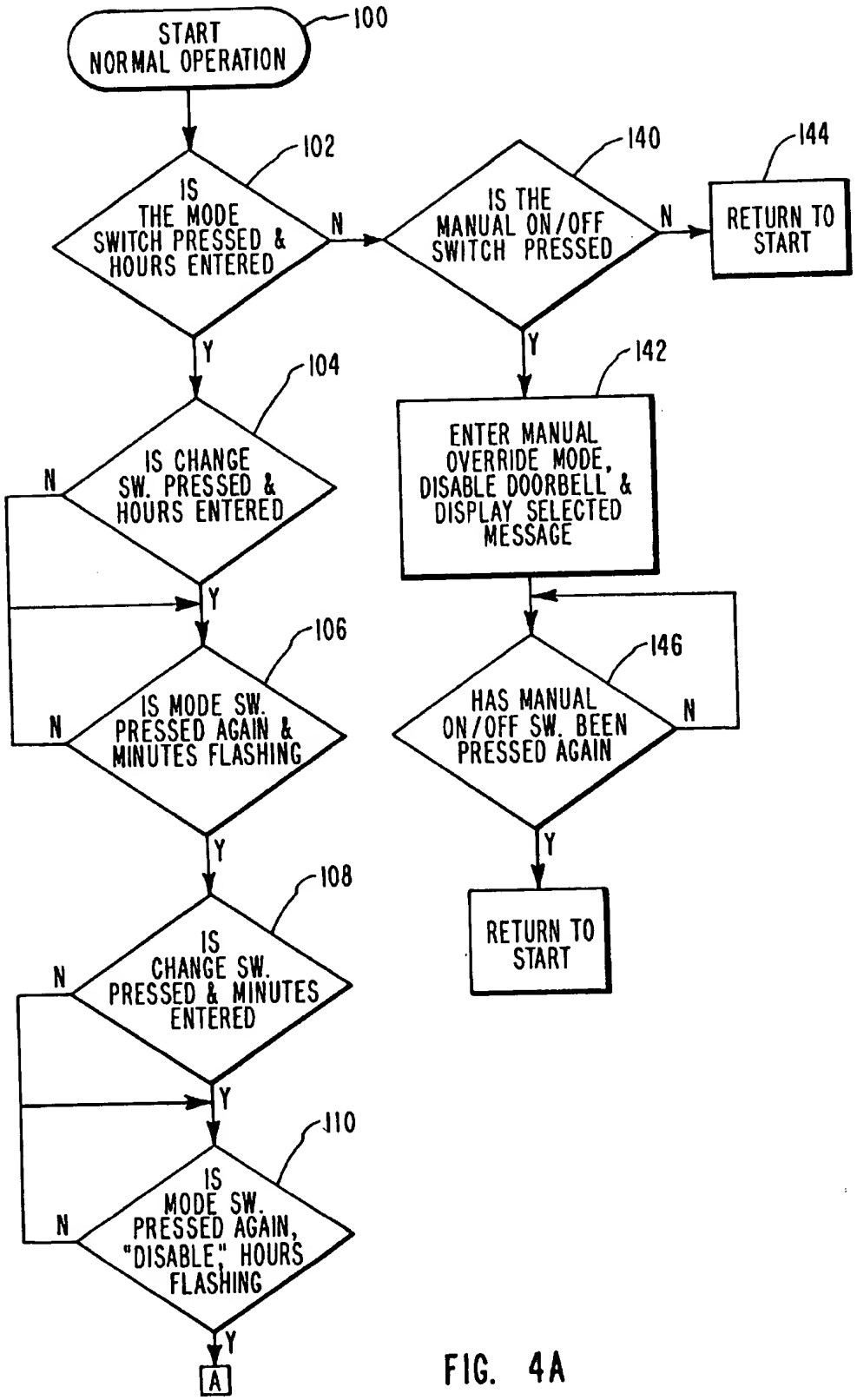

START NORMAL OPERATION
100
IS THE MODE SWITCH PRESSED & HOURS ENTERED
102
N
Y
IS THE MANUAL ON/OFF SWITCH PRESSED
140
N
RETURN TO START
144
Y
ENTER MANUAL OVERRIDE MODE, DISABLE DOORBELL & DISPLAY SELECTED MESSAGE
142
IS CHANGE SW. PRESSED & HOURS ENTERED
104
N
Y
IS MODE SW. PRESSED AGAIN & MINUTES FLASHING
106
N
Y
HAS MANUAL ON/OFF SW. BEEN PRESSED AGAIN
146
N
Y
RETURN TO START
IS CHANGE SW. PRESSED & MINUTES ENTERED
108
N
Y
IS MODE SW. PRESSED AGAIN, "DISABLE," HOURS FLASHING
110
N
Y
A

FIG. 4A

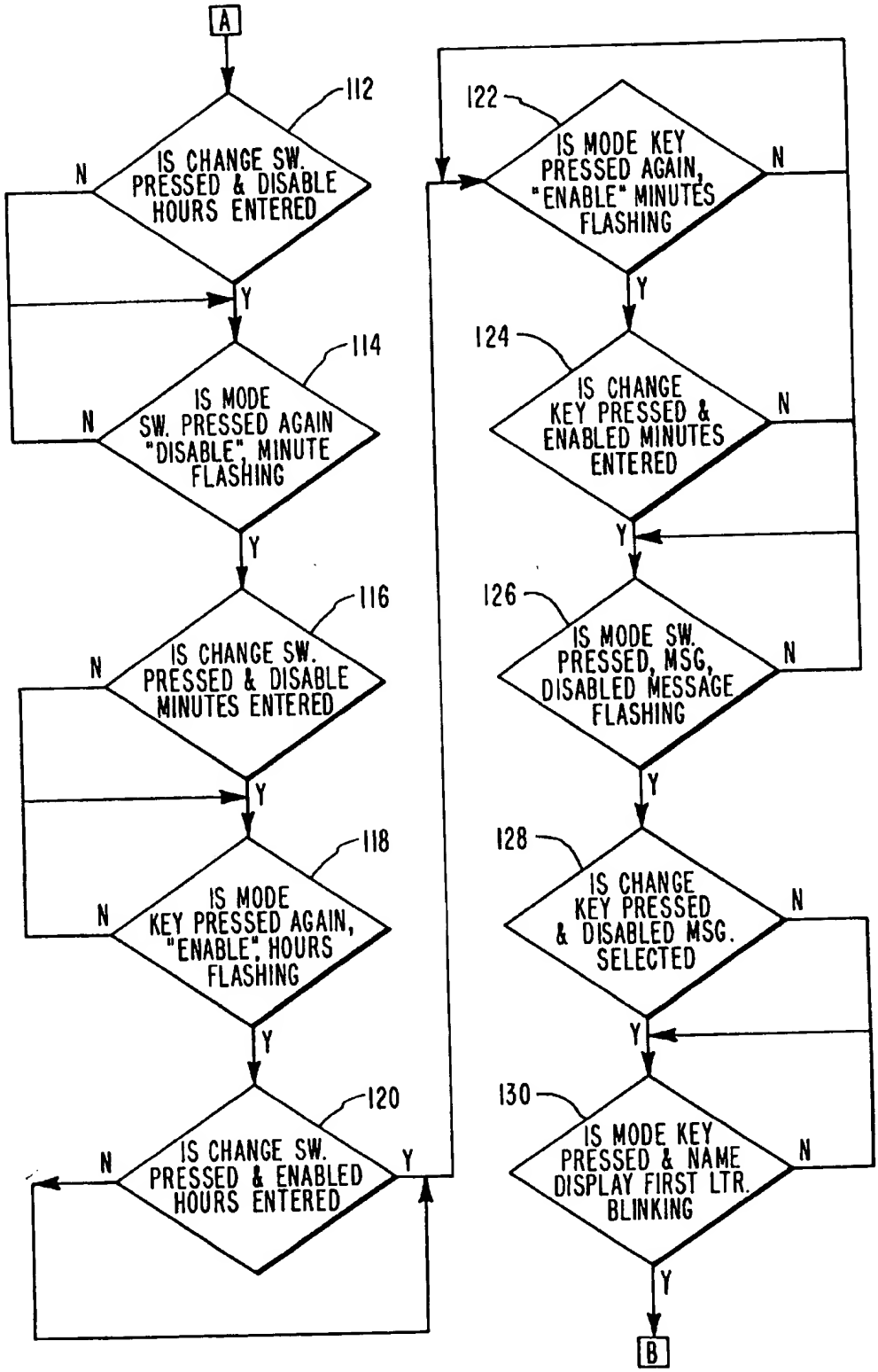

A
112
IS CHANGE SW. PRESSED & DISABLE HOURS ENTERED
N
Y
114
IS MODE SW. PRESSED AGAIN "DISABLE", MINUTE FLASHING
N
Y
116
IS CHANGE SW. PRESSED & DISABLE MINUTES ENTERED
N
Y
118
IS MODE KEY PRESSED AGAIN, "ENABLE", HOURS FLASHING
N
Y
120
IS CHANGE SW. PRESSED & ENABLED HOURS ENTERED
N
Y
122
IS MODE KEY PRESSED AGAIN, "ENABLE" MINUTES FLASHING
N
Y
124
IS CHANGE KEY PRESSED & ENABLED MINUTES ENTERED
N
Y
126
IS MODE SW. PRESSED, MSG, DISABLED MESSAGE FLASHING
N
Y
128
IS CHANGE KEY PRESSED & DISABLED MSG. SELECTED
N
Y
130
IS MODE KEY PRESSED & NAME DISPLAY FIRST LTR. BLINKING
N
Y
B

FIG. 4B

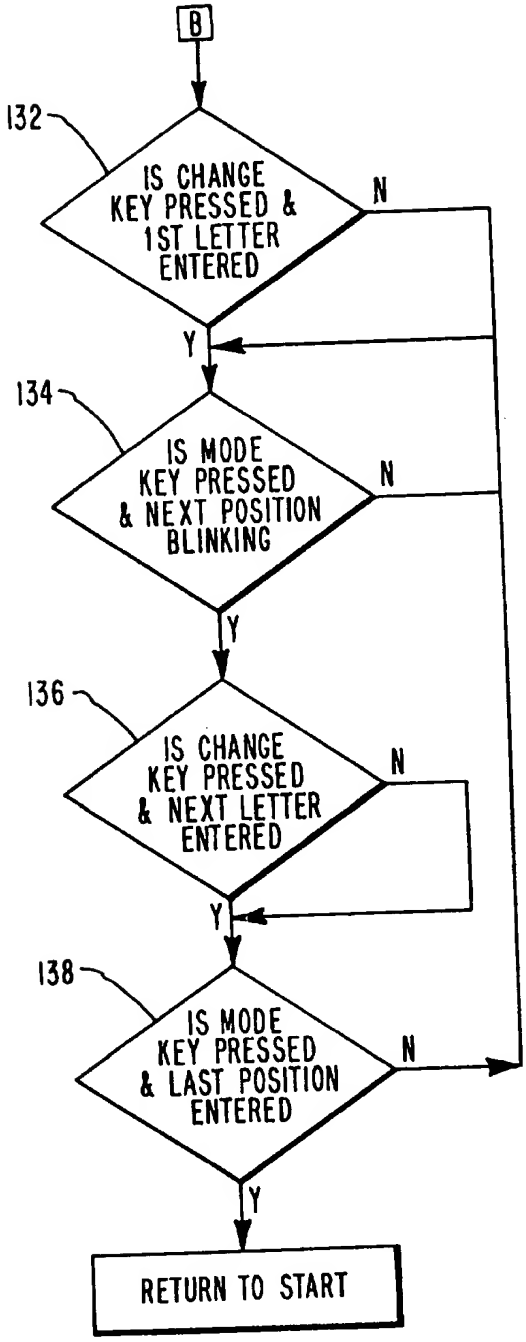

B
132
IS CHANGE KEY PRESSED & 1ST LETTER ENTERED
N
Y
134
IS MODE KEY PRESSED & NEXT POSITION BLINKING
N
Y
136
IS CHANGE KEY PRESSED & NEXT LETTER ENTERED
N
Y
138
IS MODE KEY PRESSED & LAST POSITION ENTERED
N
Y
RETURN TO START

FIG. 4C

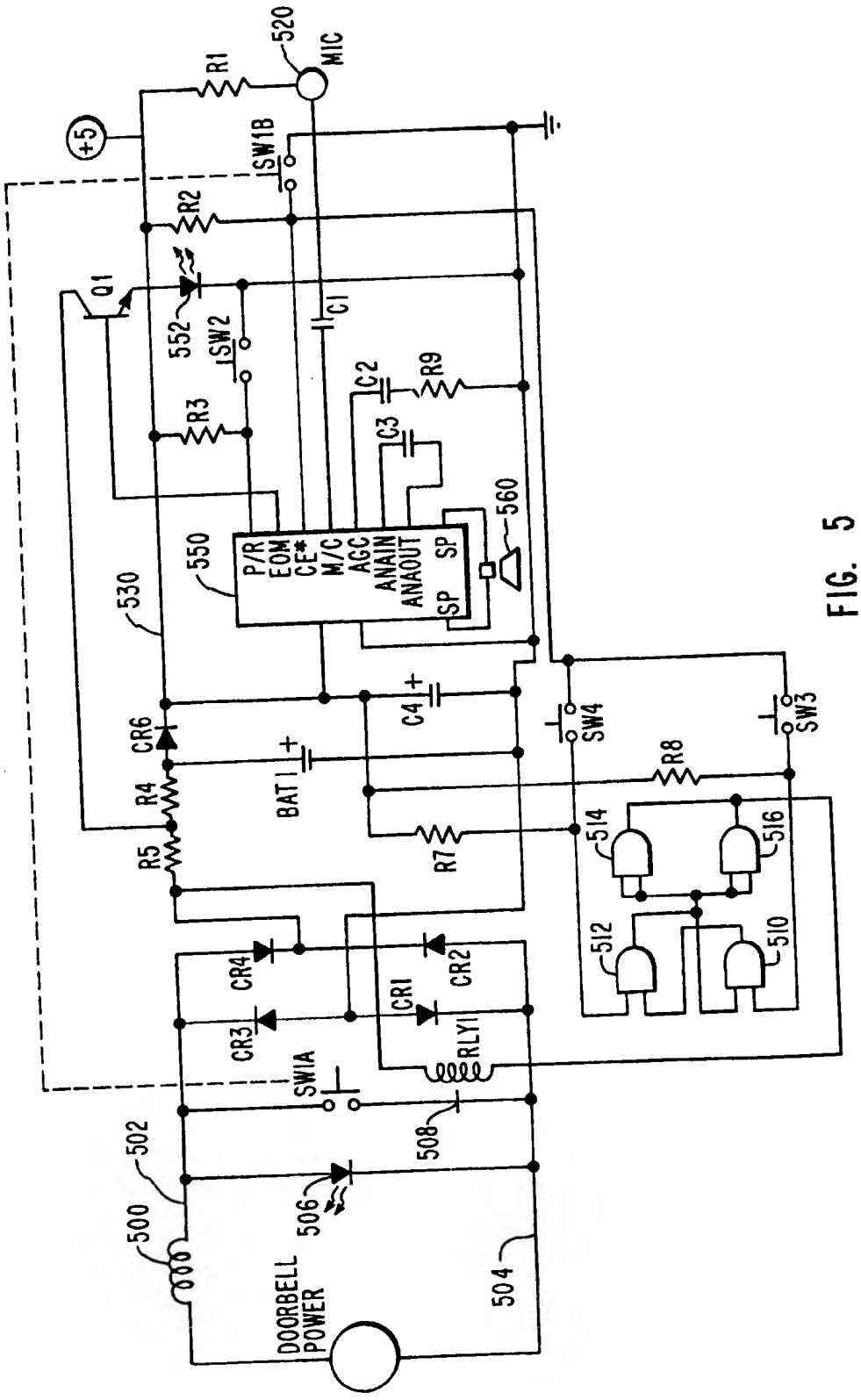

R1
520
MIC
+5
SW1B
R2
Q1
552
SW2
C1
C2
R9
R3
C3
560
550
P/R
EOM
CE*
M/C
AGC
ANAIN
ANAOUT
SP
SP
530
C4
SW4
SW3
CR6
BAT1
R8
R4
R5
R7
514
516
512
510
CR4
CR2
CR1
CR3
RLY1
SW1A
508
502
506
500
504
DOORBELL
POWER

FIG. 5

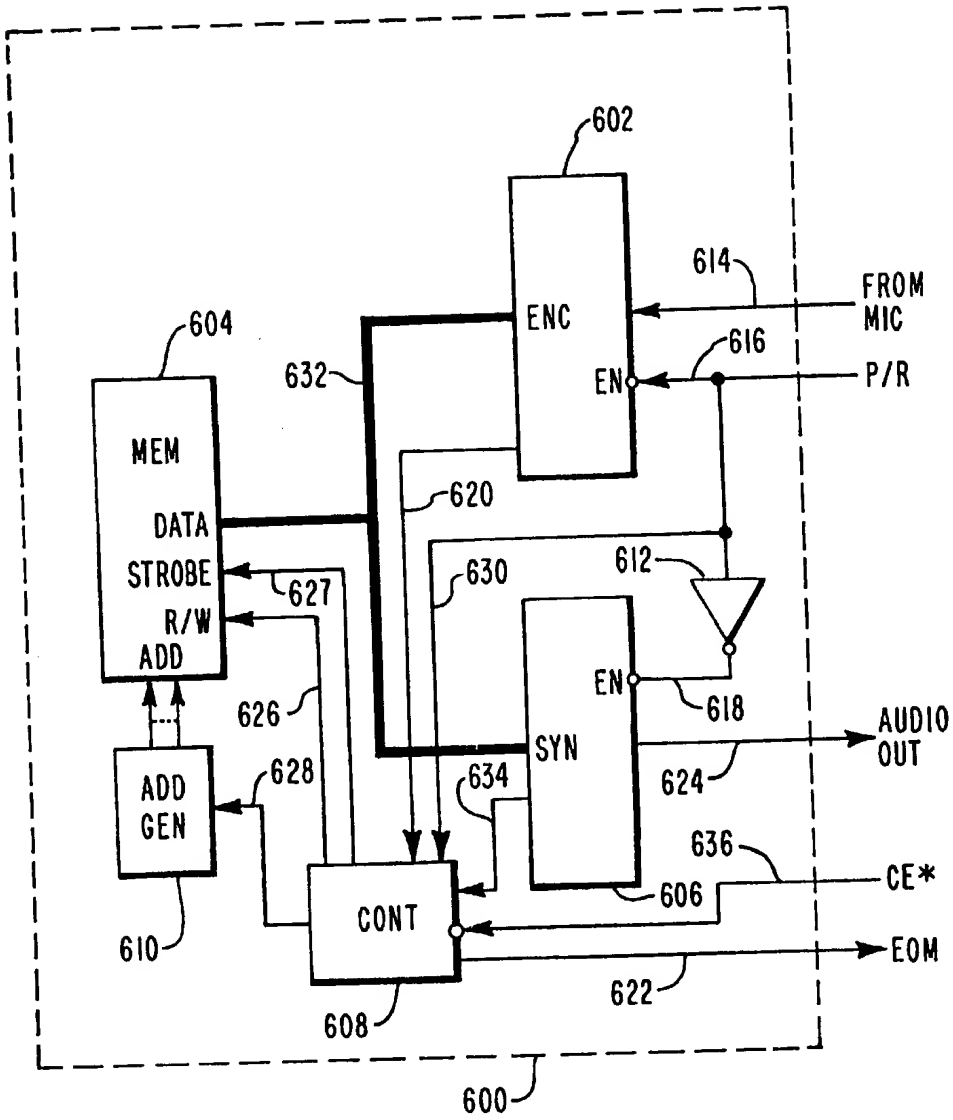

602
614
FROM MIC
604
ENC
616
632
EN
P/R
MEM
620
DATA
STROBE
627
630
612
R/W
ADD
EN
626
618
AUDIO OUT
SYN
624
ADD GEN
628
634
636
CE*
606
CONT
610
EOM
622
608
600

FIG. 6

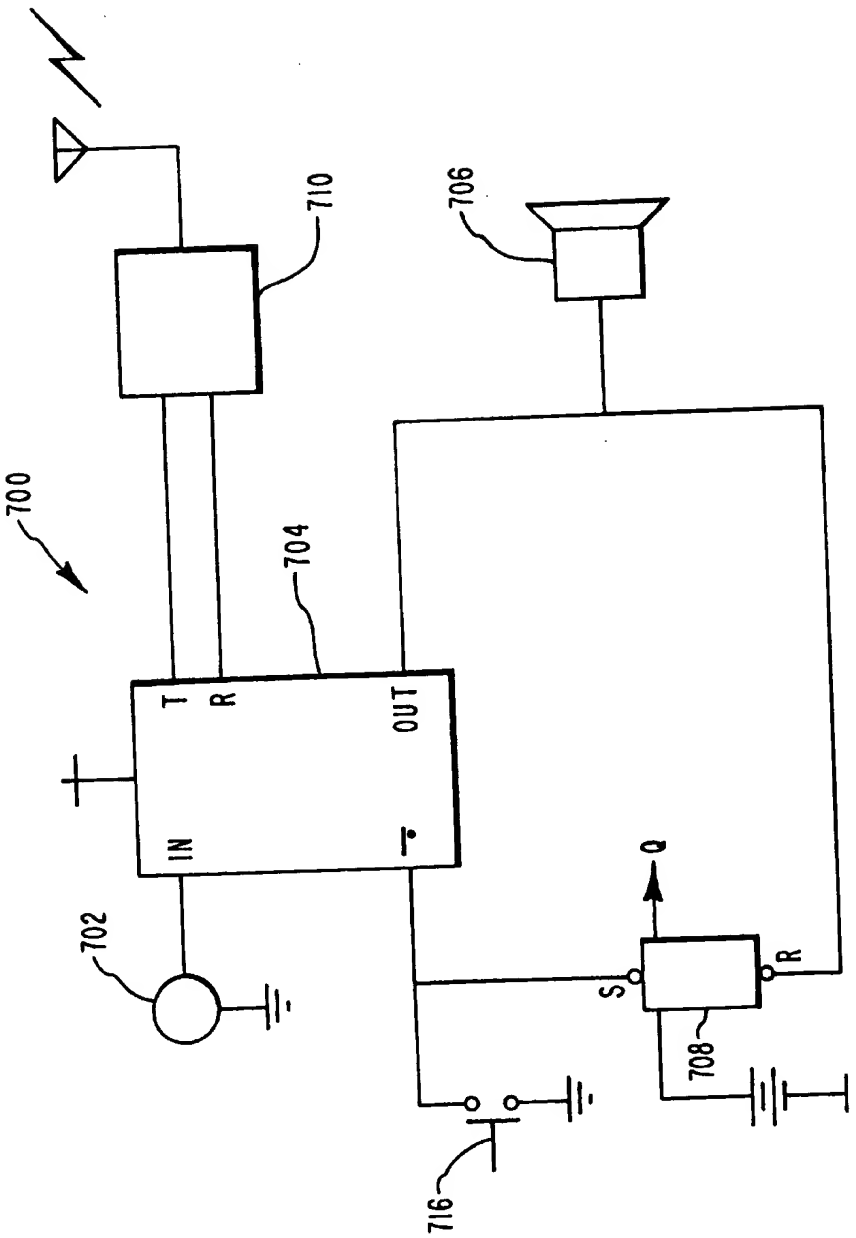


FIG. 7

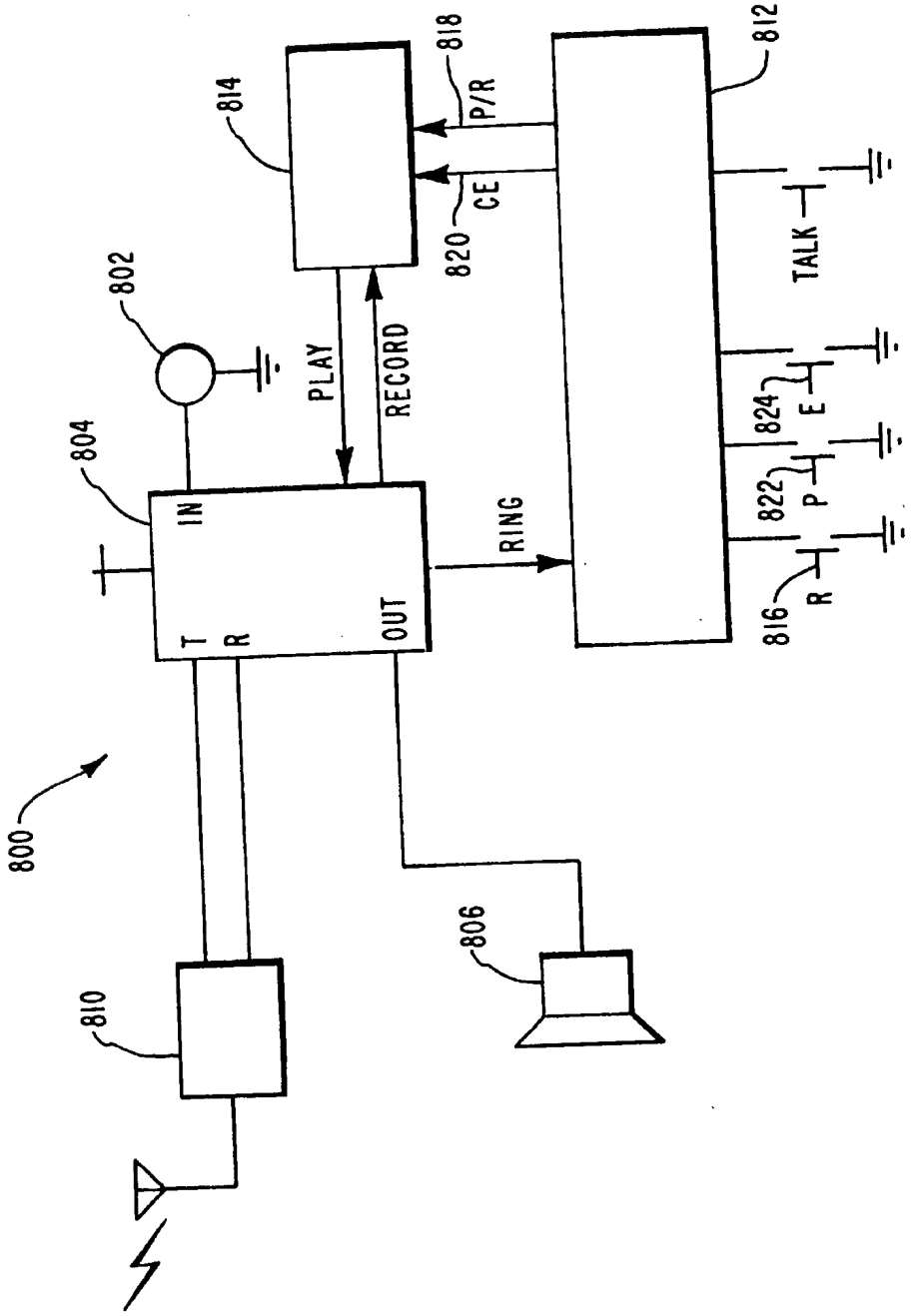

800
802
804
IN
T
R
OUT
806
810
812
814
816
R
818
P/R
820
CE
822
P
824
E
PLAY
RECORD
RING
TALK

FIG. 8

PROGRAMMABLE DOORBELL CONTROL

RELATED APPLICATIONS

This application is a continuation-in-part of my co-pending application Ser. No. 08/062,615, filed on May 11, 1993 for PROGRAMMABLE DOORBELL CONTROL, now abandoned, which is a continuation of application Ser. No. 07/735,096, filed Jul. 23, 1991 for PROGRAMMABLE DOORBELL CONTROL, now issued as U.S. Pat. No. 5,210,520, which is a continuation of application Ser. No. 07/408,613, filed Sep. 18, 1989, now abandoned, which is a continuation-in-part of an application entitled PROGRAMMABLE DOORBELL CONTROL, filed Jul. 15, 1987 and assigned Ser. No. 073,456, now issued as U.S. Pat. No. 4,868,540.

FIELD OF THE INVENTION

This invention relates to controllers and more particularly to a self-contained doorbell controller having the capability to record and playback audio messages by means of a wireless intercom system.

BACKGROUND OF THE INVENTION

In the past a doorbell switch, annunciator, and chime device included a case having a lower window for displaying a name card, an upper window for displaying messages, and a doorbell pushbutton switch located between them. A dial was provided around the pushbutton switch; the dial was manually set to identify the expected return time of an absent occupant. Lamps were positioned behind the upper slot for illuminating a photographic film positioned in the upper slot. The photographic film contained the messages the occupant desired to display. The lower slot was designed to receive a name card for display. A two-way switch was connected between the pushbutton switch, lights, and chime. The switch could be thrown to a first position to connect the lights to a source of power to illuminate the message and to break the doorbell circuit and to a second position to turn off the lights and connect the doorbell. Those persons skilled in the art desiring more information of this prior art device are referred to U.S. Pat. No. 2,343,009 issued Feb. 29, 1944 to J. A. Hall.

Another prior art device included a musical door chime connected to a clock for annunciating the time. The device includes a read only memory (ROM) for storing a repertoire of musical tunes, one of which is displayed when a doorbell pushbutton switch is pressed. The tune to be played is selected by a keyboard connected to a microprocessor. The microprocessor reads from memory each digitally-encoded musical note for a note strike and decay circuit. This circuit converts the digital note to analog signals for energizing a loudspeaker. In addition, a clock generates the time for the microprocessor to automatically ring the chimes to indicate the hour of the day. Those persons skilled in the art desiring more information for this device are referred to U.S. Pat. No. 4,326,276 issued Apr. 20, 1982 to W. M. Scott, Jr.

Other prior art doorbell devices of interest includes a door signal regulator circuit which rings the bell at a constant rate regardless of whether the pushbutton is depressed only momentarily or for a long period of time (U.S. Pat. No. 2,909,771 issued Oct. 20, 1959). Another doorbell with hour-of-return indicator, includes a doorbell enabling switch and two dials (hours and minutes) concentrically mounted about the pushbutton switch for setting and lighting the time of return in a window when the doorbell is cut off and

enabling the doorbell when non-lettered spaces of the dials are positioned in the window. Still another door signal device includes a key-controlled lock switch to provide a visual indication when the occupant is absent and has locked his door. The doorbell is cut off when the door is locked (U.S. Pat. No. 2,039,975 issued May 5, 1936).

Major differences between the prior art devices and the present invention exist. The programmable doorbell control device of the present invention is a low power device connectable to existing household wiring. In the alternative, the programmable doorbell control may be self-contained and powered by a conventional battery power source. The device has automatic and manual modes of operation. The automatic mode provides a means of disabling and re-enabling the doorbell by programming the device to perform these functions at a specified time, if desired. When disabled, the programmable doorbell control will display a selected one of a plurality of messages and sound an audible tone when the doorbell button is pressed in order to direct the visitor's attention to the displayed message. When desired, the manual mode is selected to override the automatic operation mode. In addition, the device continuously displays the name of the party occupying the home.

Thus, a visitor pushing a doorbell button hears a tone directing his attention to the display for receiving a message. A repertoire of messages including a PLEASE KNOCK message to localize the sound when an occupant such as, for example, a baby is sleeping and not to be disturbed; or if the occupant is a daytime sleeper, a DAYTIME SLEEPER message; or if the occupant does not want to be disturbed, a DO NOT DISTURB message can be displayed. These differences constitute features which are all advantages over the prior art.

However, the above described doorbell control is inconvenient if it is to be sold or used in several different countries where different languages are spoken. In this case, the messages which are displayed must be reprogrammed in each language before the device can be used. Accordingly, a second embodiment of the present invention is disclosed in which a recording and playback device is used to first record a message spoken by the user in his native language and, subsequently to playback the recorded message when the doorbell button is pushed. Similarly, the programmable doorbell control device of the present invention incorporates the capability for an occupant and/or visitor to record and playback an audible announcement or message by means of a speech controller integrated circuit and a wireless intercom system. Moreover, the recording and reproducing capabilities of the doorbell controller can be used either with or without an internal timer.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

In view of the foregoing, it is a primary object of the present invention to provide a low cost self-contained programmable doorbell control system.

Another object of the present invention is to provide a programmable doorbell control system having automatic and manual operational modes.

Yet another object of the present invention is to provide a programmable doorbell control system having an instructional information message display capability.

Still another object of the present invention is to provide a programmable doorbell control system which automatically disables and enables the doorbell at preselected times, if desired.

A further object of the present invention is to provide a programmable doorbell control system in which an audible announcement or message can be recorded by an occupant for playback when a doorbell actuation means is actuated.

Still a further object of the present invention is to provide a programmable doorbell control system in which audible messages can be recorded and played back using low cost circuitry.

Additionally, it is an object of the present invention to provide a programmable doorbell control system which is capable of transmitting an audible announcement or message spoken by an occupant or a visitor by means of a wireless intercom system.

Consistent with the foregoing objects, and in accordance with the invention as embodied and broadly described herein, a programmable doorbell controller is disclosed in one preferred embodiment of the present invention as providing a programmable doorbell control for either automatically or manually controlling the operation of a doorbell depending upon the positioning of a mode selection switch.

In the automatic mode, a controller interfaces with the operator, keeps the time of day, controls the enabling and disabling of the doorbell, controls a tone generator, and controls a display or audible communication means. In one preferred embodiment of the present invention, the occupant enters his name, selects a message for display, sets the clock to the current time of day, and sets the times for enabling and disabling the doorbell. When the doorbell actuation means, preferably a pushbutton switch, is actuated or depressed, the tone generator generates a tone for directing a visitor's attention to the display and the display displays an informational message selected from a repertoire thereof. In addition thereto, the name of the house occupant is continuously displayed on the display.

In the manual mode, the internal system operations of the doorbell controller are bypassed and control of the doorbell is returned directly to the doorbell actuation switch.

In the second embodiment, an audible announcement is recorded using digital technology. In particular, the occupant records a message by speaking into a microphone. The analog signals generated by the microphone are encoded into digital signals by means of a speech encoding integrated circuit. The resulting digital signals are stored in an integrated circuit memory. Later, when the doorbell is pushed the stored digital signals are retrieved from the memory and provided to an integrated circuit speech synthesizer which generates audio analog signals. The audio signals are amplified and used to drive a speaker which generates a reproduction of the audible announcement or message.

In an alternate embodiment of the present invention, an audible announcement is recorded and stored by a doorbell control module using speech controller integrated circuitry. In particular, the occupant records a message or announcement by speaking into a microphone housed within a doorbell control module. Analog electrical signals are generated by a microphone and encoded by the speech controller integrated circuit for storage by a microcomputer on a speech chip. Later when the doorbell actuation means is actuated by a visitor, stored analog electrical signals are retrieved from the internal memory of the microcomputer and processed by the speech controller integrated circuit, thus generating an output of audio analog signals. Accordingly, the output audio signals are amplified and used to drive a loudspeaker to produce an audible reproduction of the message or audible announcement recorded by an occupant.

As a variation of the alternate embodiment generally described above, the programmable doorbell control of the present invention includes a self-contained remote module which interfaces with the doorbell control module by means of a wireless intercom system. When the doorbell actuation means, preferably formed on the facing of the remote module, is actuated or depressed by a visitor, the remote module simultaneously transmits a tone or signal which can be received and detected by the doorbell control module, preferably positioned within the premises of the building or home. In response, the doorbell control module activates its internal speech controller integrated circuit and internal components to generate a playback of the stored audible announcement previously recorded by the occupant. Similarly, a visitor can easily respond to an occupant's audible announcement or message by actuating or depressing a recording actuation means of the remote module to activate a microphone to generate a responsive audible announcement or message which can be transmitted by means of the wireless intercom system to the control module for encoding and storage. In this manner, the visitor's audible announcement or message is encoded, recorded and stored by the speech controller integrated circuitry of the control module for playback by the occupant.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and features of the present invention will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only typical embodiments of the invention and are, therefore, not to be considered limiting of its scope, the invention will be described with additional specificity and detail through the use of the accompanying drawings in which:

FIG. **1** is an isometric view of a programmable doorbell control device illustrating one presently preferred embodiment of the present invention;

FIG. **2** is a block schematic diagram illustrating one presently preferred representation of the programmable doorbell control circuit of one presently preferred embodiment of the programmable doorbell control;

FIG. **3** is a block schematic diagram illustrating one presently preferred configuration of the controller of one presently preferred embodiment of the programmable doorbell control;

FIG. **4** is a flowchart illustrating one presently preferred representation of the logic flow of one presently preferred embodiment for setting the operational parameters of the programmable doorbell control;

FIG. **5** is a circuit schematic diagram illustrating one presently preferred configuration of an electrical circuit for recording and generating an audible announcement of one presently preferred embodiment of the programmable doorbell control;

FIG. **6** is a block schematic diagram illustrating one presently preferred representation of the speech recording and playback circuitry of one presently preferred embodiment of the programmable doorbell control;

FIG. **7** is a block schematic diagram illustrating one presently preferred configuration of the remote module of one presently preferred embodiment of the programmable doorbell control; and

FIG. **8** is a block schematic diagram illustrating one presently preferred configuration of the control module of

one presently preferred embodiment of the programmable doorbell control.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

It will be readily understood that the components of the present invention, as generally described and illustrated in the Figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the system and method of the present invention, as represented in FIGS. **1** through **8**, is not intended to limit the scope of the invention, as claimed, but it is merely representative of the presently preferred embodiments of the invention.

The programmable doorbell control device **10** (FIG. **1**) includes a housing **12** having a front panel **14**. The front panel includes a doorbell actuation means **16** and a display **18** such as, for example, a liquid crystal display or any other conventional display means. As illustrated herein, the doorbell actuation means **16** of the presently preferred embodiment incorporates a pushbutton switch. It will be readily appreciated, however, that other types of suitable doorbell actuation means **16**, such as, for example, a pressure sensitive switch, a touch sensitive switch, a slide switch, a momentary or non-momentary switch, a pressure sensitive floor mat, an infrared beam, etc. are possible. In one preferred embodiment of the present invention, the housing **12** has a bottom **20** having mounted therein multiple control switches including, for example, a switch **22** for selecting either the automatic or manual operation mode, an enable/disable mode switch **24** and a change switch **26**. Preferably, the enable/disable mode and change switches **24** and **26** are conventional pushbutton switches for setting and changing the operational parameters of the programmable doorbell device **10**. It will be readily appreciated, however, that other suitable forms of mode switch **24** and/or change switch **26**, such as, for example, a pressure-sensitive switch, a slide switch, a toggle switch, etc. are readily possible. The housing **12** houses the internal circuitry including the electronic circuitry for the programmable doorbell device **10**.

The electronic circuitry **28** (FIG.**2**) for the solid state programmable doorbell device **10** includes a power source **30** connected by leads **32** and **33** for supplying power to a controller **34**, liquid crystal display (LCD) **18** and tone generator **36**. The power source **30** is separate from the house power supply. Preferably, the power source **30** comprises a small, inexpensive watch battery; thus, existing electric doorbell switches are replaced without requiring the expertise and expense of an electrician or any change in the house wiring. It will be appreciated, however, that those skilled in the art will readily recognize that other suitable power sources which are consistent with the spirit and scope of the present invention are possible. The control switches, including enable/disable mode switch **24**, change switch **26** and manual switch **22** are typical state-of-the-art switches connected to the controller for purposes hereinafter described. The control switches provide a short pulse to a detection circuit. Debouncing circuitry is in the controller to minimize the external component count and to simplify the manufacturing process.

The controller **34** is preferably connected by bus **42** to the LCD display which includes the display drivers. The LCD display bus **42** includes an 8-bit data bus, a 4-bit address (character select) bus, a strobe signal line to synchronize communication between the display and the display control circuit and a blink line which, when active high, causes the character being sent to be blinked on the display. In the preferred embodiment, it is not necessary for the display to get data for the messages from the display control circuit; all that is needed is a pointer directing the display to the correct message.

The display **18** is a three-segment LCD display of typical LCD display construction. The display includes a twelve-character display segment for the occupant's name and two seven-character display segments for the information message to be displayed. The controller **34** is also connected by leads **44** and **46**, respectively, to the tone generator **36** and doorbell control circuit **48** for control purposes.

The tone generator is a typical tone generator including an oscillator and transducer. When the tone strobe output of the controller becomes active, the oscillator will engage and provide a short tone burst to the transducer for generating an audible frequency suitable for signalling purposes. The doorbell control circuit **48** includes a electronic switch, such as, for example, a TRIAC having its gate connected to a bell enable control output of the controller. The TRIAC controls the application of household power to a suitable electric doorbell **50** connected in series therewith. Thus, if the doorbell enable signal is active and the doorbell pushbutton switch **16** is pressed, the doorbell will ring in the house; otherwise, if the doorbell enable signal is not active and the doorbell pushbutton switch **16** is pressed, the doorbell will not ring.

Referring now to FIG. **3**, the controller **34** includes a clock **52** connected to a memory **54** and a doorbell enable control circuit **56**. The memory **54** is connected to a display control **58** and to the doorbell enable control circuit **56**. The doorbell enable control circuit **56** is connected to the manual on/off switch **22** and to the doorbell control circuit **48**. The display control **58** is connected to the enable/disable mode switch **24** and change switch **26** and outputs control signals to the LCD display **18** and tone strobe signals to the tone generator.

In one preferred embodiment, the function of the clock **52** is to fetch the present time of day from memory, wait approximately one minute and write the new time back to the time of day register in memory **54**. The clock includes an oscillator and a counter (not shown). Once the correct count is observed at the counter output, preferably a minute has expired causing the memory to be updated with the new time.

The memory **54** stores all of the programmed information. The only parameter which will be altered once the device is programmed is a time of day which changes by the minute.

The display control **58** supplies the custom LCD display **18** with the data to be displayed in the twelve character name display. The display **18** (FIG. **2**) is used while programming in order to prompt the operator for the required parameters and it also displays the house occupant's name during normal operation. Thus, the data displayed in this segment of the display is changed depending upon the operation mode.

In operation, the display control **58** (FIG.**3**) of the preferred embodiment provides the LCD **18** with a stream of **12** one byte ASCII coded characters, a 4-bit decoding nibble, a strobe pulse and a blink character signal. The display control circuit also provides the display **18** with a 2-bit disable message select signal.

The display control **58** interfaces with the operator through the enable/disable mode and change switches **24** and **26** (FIG. **2**). The display control circuit (FIG. **3**) detects the actuation of the enable/disable mode switch **24** and increments the parameter in memory **54** pointed to by an

address counter to the next value each time the change switch **26** is actuated or pressed. The display control circuit enters the normal operation mode when the last parameter is entered and the enable/disable mode switch **24** is actuated. In the normal operation mode, the name of the occupant and selected message to be displayed are sent to the LCD display **18**.

The doorbell enable control circuit **56** fetches the doorbell disable time and the time of day from memory **54**, compares them and determines if the doorbell should be disabled. Once disable, the doorbell enable control circuit **56** fetches the enable time and the time of day and compares those to determine if the doorbell should again be enabled. Thus, the circuit will provide the doorbell control **48** (FIG.2) with an active "high" signal at the doorbell enable output when the doorbell is enabled, and an inactive "low" signal when the doorbell is disabled. The doorbell control circuit **56** also monitors the manual on/off switch **22**; while in the manual "on" position, all other functions of the doorbell enable control circuit **56** are disabled.

FLOWCHART

The programming of the controller is described in connection with a flowchart (FIG. 4) as follows.

At start **100**, with the doorbell in normal operation, to set or correct the clock's time of day, a decision **102** is made whether the mode switch has been pressed and the hours display blinking; else a manual on/off switch subroutine beginning with decision **140** is entered. If decision **102** is yes, a decision **104** is made whether the change switch has been pressed and the hour entered; if yes, a decision **106** is made whether the mode switch has been pressed again, else the decision **106** is made directly whether the mode switch has been pressed again. When decision **106** is yes, a decision **108** is made whether the change switch has been pressed and minutes entered; if yes, a decision **110** is made whether the mode switch has been pressed, a "DISABLE" message displayed and hours flashing; else decision **110** is made directly.

When decision **110** is yes, the mode switch has been pressed again, a "DISABLE" message displayed and the disable hour display blinking, a decision **112** is made whether the change switch has been pressed and the disable hour entered; if yes, a decision **114** is made whether the mode switch has been pressed, the "DISABLE" message displayed and the disable minutes display blinking, else the decision **114** is made directly. When decision **114** is yes, a decision **116** is made whether the change switch has been pressed and the disable minutes entered; if yes, decision **118** is made whether the mode key has been pressed and "ENABLE" message displayed and the enable hours display blinking, else decision **118** is made directly.

When decision **118** is yes, the mode key has been pressed and the enable hours display is blinking, a decision **120** is made whether the change switch has been pressed and enable hours entered; if yes, a decision **122** is made whether the mode key has been pressed, the "ENABLE" message displayed and the enable minutes display blinking, else decision **122** is made directly. When decision **122** is yes, a decision **124** is made whether the change switch has been pressed and the enable minutes entered; if yes, a decision **126** is made whether the mode switch has been pressed, a "MESSAGE" message displayed and the disabled message display blinking, else the decision **126** is made directly. When decision **126** is yes, a decision **128** is made whether the change key has been pressed and the disable message selected; if yes, a decision **130** is made whether the mode switch has been pressed and the first letter of the name display blinking; else decision **130** is made directly.

When decision **130** is yes, a decision **132** is made whether the change key has been pressed and a first letter entered. If decision **132** is yes, a decision **134** is made whether the mode switch has been pressed and the next letter position blinking; else decision **134** is made directly. If decision **134** is yes, a decision **136** is made whether the change key has been pressed and the next letter entered. When decision **136** is yes, a decision **138** is made whether the mode key has been pressed and the last position entered; else decision **138** is made directly. When decision **138** is yes, return is made to start, else return is made to step **134** and steps **134, 136** and **138** repeated until decision **138** is yes and return is made to start (normal operation).

Returning now to decision **140**, the manual on/off switch subroutine begins with the decision **140** as to whether the manual on/off switch is in the "on" position; if yes, an instruction **142** is issued to override the mode, disable doorbell, and display selected message; else an instruction **144** is issued to return to start **100**. After instruction **142** is issued a decision **146** is continuously made to determine whether the manual on/off switch has been pressed again; if yes, return is made to start, else the decision **146** is continuously made until the decision is yes and return is made to start for normal operation.

It will be appreciated by those skilled in the art that the foregoing logic flowchart can be implemented using state-of-the-art gate array technology. Thus, with the clock set to the correct time, the doorbell disable time and enable time entered correctly, the occupant's name entered and the message to be displayed selected, the programmable doorbell controller is ready for operation.

In operation, when a visitor arrives, he finds the occupant's name displayed on the LCD display **18** to ensure he is at the correct address. When the visitor presses the doorbell pushbutton switch **16**, a tone will direct attention to the LCD message display **18**. If the visitor has arrived during the time the doorbell is disabled, the message will advise the visitor whether to knock on the door, to not disturb the occupant, or that the occupant is a daytime sleeper. These messages, though typical, are examples only and these and additional or other messages can be programmed into the doorbell control system at the factory level. In a more sophisticated embodiment of the present invention, the occupant can enter desired messages in the same manner as the occupant's name is entered. Should the occupant, for any reason, desire normal operation during the disable period, the manual on/off switch can be actuated or pressed to override the controller. Automatic control is again established by actuating the manual on/off switch once again.

Those of ordinary skill in the art will, of course, appreciate that various modifications to the logic flow diagram of FIG. **4** may be easily made without departing from the essential characteristics of the invention, as described herein. Thus, the detailed logic flowchart of FIG. **4** is intended only as an example, and it simply illustrates one presently preferred embodiment of a logic flowchart that is consistent with the invention as disclosed and claimed herein.

A circuit diagram representing a presently preferred configuration of the electrical circuitry for recording and generating an audible announcement of the present invention is shown in FIG. **5**. This embodiment has the advantage that the occupant can "program" a message by speaking into a

microphone to generate a stored message. The stored message is later played back when the doorbell switch is pressed. Thus, this embodiment can be sold or used in various countries where different languages are spoken. Since there is no preprogrammed message, exactly the same circuitry can be used in all languages. Although the alternate embodiment shown in FIG. **5** does not include a timer, the speech storage and retrieval circuitry disclosed can be used in place of the message display **18** and tone generator **36** shown in FIG. **2** of the previous embodiment. If, however, an internal system clock or timer is used in correlation with the speech storage and retrieval circuitry of the present invention, the operational parameters of the programmable doorbell control **10** would comply with substantially the same logic flow diagram as set forth in FIG. **4**, with the exception that a message would not be selected from a repertoire of messages for display on an LCD display pursuant to decisions **126**, **128** and **142**. Rather, this alternate embodiment of the programmable doorbell control **10** would provide means for enabling speech controller integrated circuitry to record and playback an audible announcement generated by an occupant when the doorbell actuation means **16**, preferably a pushbutton switch, is actuated by a visitor.

As shown in FIG. **5**, electrical power is applied to the electronic doorbell from the existing house AC or DC power supply through existing house doorbell wiring. Doorbell power supplies in various areas may be AC or DC voltage of varying magnitude and the existing wiring may have variable current carrying capacity. In addition, normal operation of the doorbell pushbutton switch operates existing doorbell **500** by shorting existing wires **502** and **504** together. This short circuit removes power from the doorbell circuit when the speech storage and retrieval circuitry needs power to record or playback audible messages. Accordingly, the illustrative embodiment generates an internal DC voltage which is stabilized by an internal battery power source. Thus, the illustrative programmable doorbell control can operate with virtually any voltage and wiring. Preferably, the internal battery power source comprises a watch battery, such as, for example, a nickel cadmium battery, however, any other conventional battery power source is readily possible.

In an alternate embodiment of the present invention, electrical power is supplied to the programmable doorbell control from a stand-alone battery power source without requiring a direct wiring interface between the doorbell controller and the existing house doorbell wiring. In this regard, the battery power source generates sufficient power to the programmable doorbell control to power its integrated circuitry and internal components thereby facilitating a self-contained electronic doorbell system.

In particular, incoming electrical power (either AC or DC) is rectified to generate DC power by diodes CR1-CR4 which are connected as a full-wave bridge rectifier. Due to the rectifier circuit, even if the doorbell is connected to DC power, it is impossible to connect it with improper polarity. Assuming that the existing house power is AC, the pulsing DC power generated by diode bridge CR1-CR4 is clipped to a predetermined voltage level by resistor R5 and Zener diode CR5. Preferably, the clipped voltage is used to continuously trickle charge a nickel cadmium battery BAT1 through resistor R4. Resistor R4 is set to provide a current of $\frac{1}{1000}$ of the battery capacity, to allow for continuous charging. The resulting voltage is a regulated voltage that will always be available. The regulated voltage is reduced to a final value by series-connected diode CR6. The resulting final voltage on line **530** is then used as needed to power the electronic doorbell circuits.

For convenience, a light emitting diode (LED) **506** is connected across wires **502** and **504**. The small current which flows through, and activates, LED **506** is not sufficient to activate doorbell **500**, but LED **506** illuminates the doorbell pushbutton switch SW1B. When switch SW1B is pressed, the LED **506** will be shorted by switch SW1B and LED **506** will go out. The higher current flow through switch SW1B, wires **502** and **504** and relay contact **508** activates doorbell **500**. This operation is substantially identical to conventional illuminated, mechanical doorbell buttons.

Relay RLY1 is used to silence existing bell **500** when desired by the occupant. Relay is an AC relay powered by the unregulated pulsing DC output of rectifier bridge CR1-CR4. In order to silence bell **500**, the occupant presses the doorbell button. The doorbell button closes switches SWLA and SWLB which are mechanically ganged together. Simultaneously, the occupant momentarily presses either pushbutton switch SW4 (BELL ON) or switch SW3 (BELL OFF).

When switch SW3 has been pressed to silence bell **500**, a "low" ground signal passes through closed switch SWLA and closed switch SW3 and is applied to one input of NAND gate **510**. The output of NAND gate **510** immediately becomes "high" in response. This "high" signal is provided to one input of NAND gate **512** and, in conjunction with a "high" present at the other input of NAND gate **512** forces its output "low". This "low" output is thereupon provided to one input of NAND gate **510** and holds its output "high" even when the doorbell buttons are released. NAND gates **510** and **512** thus act as a flip flop memory circuit.

The "low" output of NAND gate **512** is provided to NAND gates **514** and **516** which act as buffers in order to generate a higher current output to drive relay RLY1. In response to the "low" input, gates **514** and **516** generate a "high" output which prevents relay RLY1 from operating. Since relay RLY1 has a normally open contact **508** in series with doorbell switch SWLB, current cannot flow to doorbell **500** when a visitor later presses the doorbell switch SW1B.

In order to allow doorbell **500** to operate when switch SW1B is pressed, the occupant simultaneously presses switches SWLA and SW4. A "low" ground signal is applied to the upper input of NAND gate **512** via switch SWLA and SW4. The output of NAND gate **512** immediately goes "high" in response. This "high" signal is applied to the upper input of NAND gate **510** and, in conjunction with the "high" signal at the lower input of NAND gate **510** forces the output of NAND gate **510** "low", thus resetting the flip flop. A "high" signal at the output of NAND gate **512** is inverted by NAND gates **514** and **516** and applied as a "low" signal to relay RLY1. This "low" signal activates relay RLYe, closing its normally open contact **508** and allows current to flow when a visitor presses the doorbell witch SWLB.

Referring to one presently preferred embodiment of the present invention, in order to record, store and playback messages, a spoken message is processed by integrated circuitry of the programmable doorbell control which first is converts the audio message into digital signals. The digital signals can then be stored in an inexpensive digital memory until playback. During playback the stored digital signals are used to drive a speech synthesizer which generates an audio playback announcement. Those skilled in the art will readily recognize other possible modifications and adaptations for storing and converting audible announcements which are consistent with the spirit and scope of the present invention, such as, for example, using an ISD chip rather than the speech synthesizer of the present embodiment to generate a recording, storage and playback of an audible announcement.

The general arrangement of the digital circuitry of one presently preferred embodiment is shown in block diagram form in FIG. 6. The record and playback circuitry **600** consists of speech encoder circuit **602**, digital memory **604**, speech synthesizer **606**, control circuit **608** and address generator **610**. The playback and record mode of the circuit is controlled by the signal on the Playback/Record (P/R) line **616**. A "low" signal on this line places the circuit in "record" mode and a "high" signal on Line P/R places the circuit in the "playback" mode.

In the "record" mode, a "low" signal on line **616** is applied to the enable input EN of the speech encoder circuit which "low" signal enables the chip. The "low" signal on line **616** is also inverted by inverter **612** and applied as a "high" signal to disable speech synthesizer circuit **606** which is used during the playback mode of operation. The "low" signal is further applied to the control circuit **608**, via line **630**, which "low" signal informs control circuit **608** that record mode is desired.

Recording is actually initiated by a "low" signal received on the chip enable CE* line **636**. In response thereto, control circuit **608** places a signal on line **626** which signal is applied to the read/write (R/W) input of memory **604** causing the memory to be placed in a write mode. Control circuit **608** also controls address generator **610** to generate address signals which are applied to the memory address inputs of memory **604** and applies a "high" signal on the end-of-message line (EOM) **622** to indicate that recording has started.

Speech encoder **602** receives analog audio signals on line **614** from a microphone (not shown in FIG. **6**). Encoder **602** samples the audio signals and generates a digital word on data bus **632** which provides the digital signals to the data inputs of memory **604**. Although bus **632** is shown as a single heavy line, typically it would consist of a plurality of signal lines since the digital words generated by encoder **602** have multiple bits. When encoder **602** has placed a digital word on data bus **632** it signals control circuit **608** via line **620**.

In response to the signals from encoder **602**, control circuit pulses memory strobe line **627** causing the digital word on bus **632** to be stored in memory **604** at the address generated by address generator **610**. Control circuit **608** then controls address generator **610** to generate another address for the next digital word.

Operation continues in this manner with encoder **602** generating digital words which are sequentially stored in memory **604** until memory **604** is full or the "low" signal on playback record line **616** is removed. When either of the latter two conditions occurs, speech conversion is ended and control circuit places a "low" signal on the end-of-message EOM line **622** as a signal that recording has been completed. If the memory **604** is not full when recording is finished, control circuit **608** generates an "end-of-message" signal which is recorded in memory **604** to mark the last digital word.

During playback operation, a "high" signal is placed on the playback/record line **616**. This "high" signal is provided to the enable input of encoder circuit **602** to disable the circuit. The "high" signal on line **616** is also inverted by the inverter **612** and applied as a "low" signal to the enable input (EN) of speech synthesizer circuit **606** to enable the circuit. The "high" signal is also applied, via line **630**, to control circuit **608** to place the control circuit in the playback mode. As with recording, playback is initiated by a "low" signal received at the chip enable input CE*.

In the playback mode, control circuit **608** places a signal on line **626** which signal is applied to the read/write input (R/W) of memory **604** to place the memory in a read state. Control circuit **608** also controls address generator **610** to generate address signals for retrieving the first digital word. Control circuit **608** then pulses strobe line **627**, causing memory **604** to place the stored digital word at the location indicated by the address signals onto data bus **632**.

The digital signals on bus **632** are applied to speech synthesizer **606**. In response to these signals synthesizer **606** generates corresponding audio signals on the AUDIO OUT line **624**. When conversion of the digital signals is complete, synthesizer **606** signals control circuit **608** via line **634**. Control circuit **608** thereupon controls address generator to generate the next address so that the next stored digital word can be retrieved from memory **604**. Operation continues in this manner with sequential digital words being retrieved from memory **604** and converted to speech signals by synthesizer **606** until the entire message has been read out of memory **604** as indicated by reading the entire message out or by reading out the stored end-of-message marker.

The operation of the message recording the playback circuitry will not be discussed further herein because the construction and operation of the circuitry is conventional and well known. For example, an integrated circuit which includes the speech encoder, decoder and associated control circuitry is manufactured by Texas Instruments, Inc. located at P.O. Box 225012-MS-84, Dallas, Tex. under the model number TMS 3477. This latter circuit can be combined in a straightforward fashion with a digital memory to produce the illustrative playback and recording circuitry.

Alternatively, a preferred playback and record circuit consisting of all the components shown in FIG. **6** plus input and output audio amplifiers is sold as a single integrated circuit designated as an "Integrated Voice Recorder" (IVR) manufactured by Information Storage Devices, 2332B Walsh Avenue, Building G, Santa Clara, Calif. 95051. In the preferred embodiment discussed below the IVR circuit is described, but it should be understood that the above mentioned TMS 3477 circuit with an accompanying memory can be substituted in a straightforward manner.

Returning to FIG. **5**, the record and playback sequence will be discussed. More specifically, in order to record a message which will be announced to a visitor when switches SW1B and SW1A are closed by pressing the doorbell button, the occupant simultaneously presses record pushbutton switch SW2 and the doorbell button which closes switch SW1A. While holding both switches closed, the occupant speaks into microphone **520**. Microphone **520** connects from power line **530** to the microphone input MIC of circuit **550** through DC blocking capacitor C1. The MIC input is connected to an internal audio amplifier whose output appears at the ANAOUT output. Capacitor C3 is used to connect the amplified analog signal to the ANAIN input of circuit **550** which is the input to the analog recording logic in circuit **550**.

When closed, switch SW2 places a "low" on the playback/record (P/R) input of the record/playback circuit **550**. As previously mentioned, the "low" signal places the playback/record circuit into a "playback" mode. Closed switch SW1A provides an "enable" signal to the chip enable input CE* of circuit **550** which, as previously described above, starts a recording operation.

As previously mentioned, circuit **550** places a "high" signal on the EOM end-of-message output when recording. The "high" signal of the EOM output is provided to tran-

sistor Qi via resistor R6. The "high" signal from the EOM output turns transistor Ql "on" allowing current to flow through Ql to LED **352**, in turn, activating LED **552**. The resulting light from LED **552** gives the occupant a visible indication that a recording is being made.

When the record switch SW2 or doorbell button SWIA is released by the occupant or the recording capacity of circuit **550** is exceeded, an end-of-message marker is recorded in circuit **550** and the EOM output becomes "low". Consequently LED **552** is deactivated. The occupant then knows that recording of the message is finished.

Subsequently when a visitor presses the doorbell switch, playback of the recorded announcement or message is initiated. More specifically, when a visitor presses the doorbell button, switches SWIA and SWIB are closed. Since the record switch SW2 is not pressed at this time, a "high" signal is provided via resistor R3 to the P/R input of circuit **550** to place it in the playback mode. Closed switch SWLA applies a "low" signal to the chip enable input CE* of circuit **550** which then activates the playback of the message as described above. The EOM output of circuit **550** will become "high" during playback, activating LED **552**. When the message finishes playing, LED **552** will go off.

Resistor R2 and capacitor C2 make up an R/C network which is used to generate an automatic gain control voltage for circuit **550** if the aforementioned IVR circuit is used. As the occupant speaks louder during message recording, the gain of the input amplifier will be decreased. As the occupant speaks softer, the gain will be increased correspondingly.

For the aforementioned IVR circuit an output speaker **560** can be connected directly to speaker outputs SP.

In addition to the foregoing, FIGS. **7** and **8** illustrate yet another alternate preferred embodiment of the programmable doorbell control. Provided as a variation of the preferred embodiment described in FIGS. **5** and **6**, this alternate embodiment consists of at least two independent interactive modules which incorporate the ability to record and playback audible announcements or messages using speech controller integrated circuitry and transmit these audible announcements or messages between modules using a wireless intercom system. This embodiment has the similar advantage that the occupant of a building or home can "program" an announcement or message by speaking into a microphone to generate a stored message for playback at a later time when the doorbell actuation means is actuated as outlined above. In addition, however, the present embodiment has the additional advantage over the embodiment illustrated in FIGS. **5** and **6** in that a visitor can "program" an audible announcement or message in response to an occupant's message by speaking into a microphone to generate a message for storage and playback by the occupant.

As shown in FIG. **7**, one presently preferred embodiment of a remote module of the present invention comprises a speech controller integrated circuit **700** which is substantially similar in function to an integrated telephone dialer. The speech controller integrated circuit **700** comprises a microphone preamplifier **702**, a hands-free speakerphone circuit **704**, loudspeaker amplifier **706** and means for transmitting and receiving a generated audible announcement or message **710**. Preferably, the means for transmitting and receiving a generated audible announcement or message comprises a radio frequency transmitter/receiver, however, any other suitable transmission means or wireless intercom system can be used so long as it satisfies the purposes and objects of the present invention. In addition, a tone generator (not shown) can be provided for transmitting a tone over an audio path which interfaces by wireless intercom with a control module (FIG. **8**). Tones generated by the tone generator provide means for signalling the control module that the doorbell actuation means on the facing of the remote module has been actuated and the internal programming routines of the programmable doorbell control engaged.

The speech controller integrated circuit **700** of the remote module is preferably housed within a small housing unit having a front facing which incorporates a doorbell actuation means **716** and an audio record button. As illustrated in the present design, the doorbell actuation means **716** incorporates a conventional pushbutton switch. It will be readily appreciated, however, that other conventional doorbell actuation means, such as, for example, a pressure sensitive switch, a touch sensitive switch, a slide switch, a momentary or non-momentary switch, a pressure sensitive floor mat, an infrared beam, etc. are possible.

In one presently preferred embodiment, the internal programming circuitry of the remote module is powered by a stand-alone battery power source or by means of solar power. In this regard, the remote module can be removably mounted as a self-contained unit on the exterior surface of a building or house near an entrance therein. It is also an important feature of the present invention to acknowledge that in place of a battery power source, power can be applied to the remote module from existing house AC or DC power supply through the existing house doorbell wiring, as illustrated in FIG. **5**.

Since the remote module of a presently preferred embodiment of the present invention is self-contained without requiring an electrical interface with existing house doorbell wiring to power the doorbell and intercom system for transmitting and receiving audible announcements or messages, battery life is important. In this regard, the speech controller integrated circuit **700** normally lies dormant until the internal programming routines of the remote module are activated by an actuation of the doorbell actuation means **716**.

When the doorbell actuation means **716** is actuated and the doorbell circuit disabled, electrical power is applied to a low-power set/reset (S/R) latch **708** and doorbell actuation switch **716** to generate the playback of an audible announcement or message recorded by the occupant. The S/R latch **708** preferably draws very little power from the power source (measured in the micro ampere range) to extend the life of the internal battery. The actuation of the doorbell switch **716** asserts a "SET" to the S/R latch **708**. This sets a "Q" output of the S/R latch "on" or high (Q). The power output is maintained by the S/R latch **708** as long as the "Q" output is maintained high. The "Q" output will remain high until a "RESET" is sent to the S/R latch **708**.

In the present embodiment, as long as sound is generated and/or transmitted by the internal speech controller circuit and interactive components of the remote or control module (FIG. **8**), the "RESET" mode will not be generated. When sound is longer being generated, the "RESET" will be initiated and the doorbell circuit opened thus removing the power supply. It will be readily appreciated by those skilled in the art that other possible modifications and/or system adaptations for generating a "RESET", such as, for example, using a voice activated switch, are possible which are consistent with the spirit and scope of the present invention.

Reference is next made to FIG. **8**, which illustrates one presently preferred embodiment of a control module of the

present invention which comprises a speech controller integrated circuit **800** that is substantially similar in internal systems design and configuration as the internal speech circuitry of the remote module described in FIG. **7**. The speech controller integrated circuit **800** of the control module includes a microphone preamplifier **802**, a hands-free speakerphone circuit **804**, loudspeaker amplifier **806** and means for transmitting and receiving a generated audible announcement or message **810**. Preferably, the means for transmitting and receiving a generated audible announcement or message comprises a radio frequency transmitter/receiver, however, any other suitable transmission means or wireless intercom system can be used so long as it satisfies the purposes and objects of the present invention.

Preferably, the speech controller integrated circuit **800** of the control module is housed within a housing unit having a front facing which incorporates an audio record button **816** and an LED. The presently preferred embodiment of the control module provides internal programming circuitry which is powered by electrical power supplied from the existing house AC or DC power supply through existing house doorbell wiring, as illustrated in FIG. **5**. It is an important feature of the present invention, however, that the control module of the present invention could be powered by a stand-alone battery power source as described in correlation with the remote module above.

A ring detector (not shown) can be provided within the internal housing of the control module for sensing tones generated by the tone generator and transmitted by means of the wireless intercom system from the remote module to the control module. Tones which are received by the ring detector of the control module provide an indication that the doorbell actuation means **716** of the remote device has been actuated, thereby activating the internal speech controller integrated circuit **800** of the control module to playback a previously recorded audible announcement or message generated by an occupant.

Preferably, the speech controller integrated circuit **800** of the control module interfaces with a microcomputer **812** and ISD chip **814**. The microcomputer **812** in combination with the speech controller integrated circuit **800** provides means for storing analog electrical signals generated by the microphone **802** on the ISD chip **814**. It will be readily appreciated, however, that other audible recording components, such as, for example, a micro-miniature tape recording unit, an analog-to-digital converter storage means, etc. are possible. When the doorbell actuation means on the face of the remote module is actuated, the microprocessor **812** assists the speech controller integrated circuit **800** in retrieving stored analog electrical signals from the ISD chip **814** to generate the occupant's audible announcement or message. Those skilled in the art will readily recognize that other possible modifications and adaptations for storing and converting audible announcements which are consistent with the spirit and scope of the present invention, such as, for example, using an analog-to-digital convertor or a speech synthesizer (as described in FIGS. **5** and **6**) to generate a recording, storage and/or playback of an audible announcement, are possible.

To program an audible announcement or message, an occupant preferably depresses and holds an audio record button (or switch) **816** which activates the record mode of the speech controller integrated circuit **800**. The microcomputer **812** sets the playback/record line **818** of the integrated speech controller circuit **800** to a Record mode and asserts a Chip Enable line (CE) **820**. The speech controller integrated circuit **800** stores the audible announcement or message presented to its microphone input pins (RECORD) as long as the CE line **820** is maintained asserted.

The electrical analog signals representative of the audible announcement or message recorded and stored by the speech controller integrated circuit **800** of the control module can be activated for playback on the remote module when the doorbell actuation means is actuated. Upon actuation of the doorbell actuation means **716**, the tone generator generates a tone which is decoded as a ringing sound detect by the ring detector interfacing with the speech controller integrated circuit **800** of the control module. The speech controller integrated circuit **800** sends a sound detection to the ring detect pin of the microcomputer **812**, thereby activating the internal programming routines of the microcomputer **812**.

When a tone is received from the remote module, the microcomputer **812** of the control module activates its internal memory and retrieves those analog electrical signals stored on the ISD chip **814** which represent the audible announcement or message recorded by the occupant. The microcomputer **812** performs this function by setting the playback/record pin **818** to the "P" state, and asserting the Chip Enable (CE) pin **820**. The speech controller integrated circuit **800** thereafter accesses the audible announcement and plays back the entire recorded message until an internal end-of-message EOM mark is sensed as disclosed in FIG. **6**.

Referring back to FIG. **7**, the remote module includes means for receiving and transmitting a generated audible announcement or message **710** which preferably comprises a wireless intercom system. It will be readily appreciated by those skilled in the art, however, that other suitable means for transmitting and receiving audible transmissions are possible. In operation, the actuation of the doorbell actuation means **716** causes a signal (tone) to be transmitted to the control module whereby the occupant's stored audible announcement or message is generated by the speech controller integrated circuit **800** of the control module and transmitted over the wireless intercom system to be played back on the loudspeaker **706** of the remote module. Preferably, a means for adjusting the volume output of the loudspeaker **706** is provided to control the volume output of the doorbell chime and the playback of an audible announcement or message.

Utilizing radio frequency transmissions or other suitable means of communication, the self-contained remote module provides a wireless intercom system which facilitates numerous functional aspects which would not otherwise be capable of fitting within the small housing of the remote module. Moreover, through the interface of the speech controller integrated circuit **700** and internal components of the remote module, a visitor can generate an audible announcement or message in response to the occupant's audible announcement. In this regard, a visitor's audible announcement or message is encoded by the speech controller integrated circuit **700** of the remote module and transmitted via the wireless intercom system to the control module where the visitor's message can be recorded for later playback by the occupant. In current design, a conventional LED is provided on the exterior front facing of the control module which flashes to represent recorded messages.

Other functions of the control module such as an Erase switch **824** for erasing stored audible announcements or messages, may be initiated by the occupant. To erase a recorded announcement or message stored by the microcomputer **812** on the ISD chip **814**, the occupant preferably actuates or presses the Erase switch **824**. The microcomputer **812** will then refuse to enter the Playback function mode

where the P/R pin is set to Playback, until a message has been recorded again.

To review a previously recorded message, the Playback message function may be initiated by pressing a Play switch **822**. The microcomputer **812** does this function by setting the P/R pin **818** to the "P" state, and asserting the Chip Enable (CE) pin **820**. The speech controller integrated circuit **800** will playback the entire audible announcement or message until an internal end-of-message EOM mark is sensed as disclosed in FIG. **6**.

Although the foregoing preferred embodiments of the programmable doorbell control of the present invention have been described, it will be apparent to one skilled in the art that various modifications to the details of construction shown and described may be made without departing from the spirit and scope of this invention. Accordingly, the described embodiments are to be considered in all respects only as illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the appended claims, rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed and desired to be secured by United States Letters Patent is:

1. A programmable doorbell system for controlling a doorbell which is connected to, and activated by a doorbell actuation means, said system comprising:

means for communicating a message comprising a display means and audio record and playback circuitry;

means for generating time-of-day signals;

means responsive to a first one of said time-of-day signals for disconnecting said doorbell from said doorbell actuation means and for enabling said communication means to communicate said message; and

means responsive to a second one of said time-of-day signals for connecting said doorbell to said doorbell actuation means and for disabling said communication means.

2. A programmable doorbell system as defined in claim **1** wherein said doorbell actuation means comprises a push-button switch.

3. A programmable doorbell system as defined in claim **1** wherein said display means comprises a liquid crystal display which displays one of a plurality of messages, and wherein said programmable doorbell system comprises means for storing and selecting one of said plurality of messages for display by said display means.

4. A programmable doorbell system as defined in claim **1** wherein said audio record and playback circuitry includes a microphone, speech controller integrated circuitry and an output speaker circuit.

5. A programmable doorbell system as defined in claim **1** wherein said time-of-day signal generating means comprises an internal system clock for generating said time-of-day signals, a memory for storing a current time-of-day, an enable time and/or a disable time, and means for comparing said time-of-day signals to said stored enable signal to generate said first one of said time-of-day signals and to said stored disable signal to generate said second one of said time-of-day signals.

6. A programmable doorbell system as defined in claim **1** further comprising means responsive to said first one of said time-of-day signals and the actuation of said doorbell actuation means for generating means to alert a visitor to acknowledge said communication means.

7. A programmable doorbell system as defined in claim **6** wherein said means for alerting said visitor includes a tone generator comprising an oscillator and transducer which produces a short tone burst for generating an audible frequency suitable for signalling purposes.

8. A programmable doorbell system according to claim **1** further comprising a manually operated means for causing said disconnecting means to disconnect said doorbell from said doorbell actuation means and to enable said communication means irrespective of said first one of said time-of-day signals.

9. A self-contained doorbell system for controlling a doorbell, said doorbell system comprising:

a doorbell actuation means;

a power supply for providing power to said doorbell system when said doorbell actuation means is actuated;

means for converting an audible announcement into electrical signals, said converting means comprising audio record and playback circuitry;

means for storing said signals, wherein said storage means comprises internal memory capacity;

means responsive to said stored signals and to actuation of said doorbell actuation means for generating an audible reproduction of said audible announcement, said generating means comprising speech controller integrated circuitry and a speaker output circuit for generating said audible announcement; and

a housing unit for housing said doorbell actuation means, said converting means, said storage means and said means for generating said audible reproduction of said audible announcement.

10. A self-contained doorbell system as defined in claim **9** further comprising means for disconnecting said doorbell from said doorbell actuation means so that said doorbell does not ring when said doorbell actuation means is actuated, but said audible reproduction of said audible announcement is generated.

11. A self-contained doorbell system as defined in claim **10** wherein said disconnecting means comprises a switch connected in series with said doorbell and said doorbell actuation means and a manually-controlled means for opening said switch to disconnect the doorbell and the doorbell actuation means.

12. A self-contained doorbell system as defined in claim **9** wherein said doorbell actuation means comprises a switch.

13. A self-contained doorbell system as defined in claim **9** wherein said power supply comprises a battery power source.

14. A self-contained doorbell system as defined in claim **9** wherein said power supply comprises means for interfacing said doorbell system with existing electrical household wiring.

15. A self-contained doorbell system as defined in claim **9** wherein said audio record and playback circuitry includes a microphone and speech controller integrated circuitry for converting said audible announcement into analog electrical signals.

16. A self-contained doorbell system as defined in claim **9** wherein said audio record and playback circuitry includes a microphone for converting said audible announcement into analog electrical signals and a speech encoder circuit for converting said analog electrical signals into digital signals.

17. A self-contained doorbell system as defined in claim **9** wherein said storage means comprises a speech controller integrated circuit chip for storing said electrical signals.

18. A self-contained doorbell system as defined in claim **9** comprising a control module and a remote module housing said doorbell actuation means.

19. A self-contained doorbell system as defined in claim 18 further comprising means for receiving and transmitting said audible announcement between said control module and said remote module.

20. A self-contained doorbell system as defined in claim 19 wherein said means for receiving and transmitting said audible announcement comprises a wireless intercom system.

21. A self-contained doorbell system as defined in claim 18 wherein said control module comprises a microphone, speech controller integrated circuitry and a speaker output circuit.

22. A self-contained doorbell system as defined in claim 20 wherein said control module further comprises a ring detector for sensing tones generated by said remote module.

23. A self-contained doorbell system as defined in claim 18 wherein said remote module comprises a microphone, speech controller integrated circuitry, a means for communicating with said control module and a speaker output circuit.

24. A self-contained doorbell system as defined in claim 23 wherein said remote module further comprises a tone generator for generating a tone which is transmitted by a communication means for signaling said control module that said doorbell actuation means has been activated.

25. A self-contained doorbell system as defined in claim 24 wherein said communication means comprises a wireless intercom system.

26. A self-contained doorbell system as defined in claim 9 wherein said speech controller integrated circuitry interfaces with a microcomputer to provide record and playback functions.

27. A self-contained doorbell system as defined in claim 9 wherein said converting means comprises a microphone and speech controller integrated circuitry for converting said audible announcement into analog electrical signals.

28. A self-contained doorbell system as defined in claim 27 wherein said converting means further comprises a speech encoder circuit for converting said analog electrical signals digital signals.

29. A self-contained doorbell system as defined in claim 9 wherein said storage means comprises a speech controller integrated circuit chip for storing analog electrical signals.

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